A Specialized System for Multiple Rearing Of Quality Honeybee Queens[1]

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ACKNOWLEDGEMENT

This paper is written as a tribute to Dr. C. L. Farrar, former leader of the U. S. Department of Agriculture Bee Management Investigations and Professor in the Department of Entomology, University of Wisconsin, Madison, under whom I had the privilege of working from 1956 until his retirement in 1963. Dr. Farrar's concepts, reached through his years of experience with bees, are reflected in the system of queen rearing currently used at the Madison laboratory. The procedures and techniques in queen rearing devised by him have now been combined and modified by me.

The size and vigor of a colony of honey bees, *Apis mellifera* L., are a direct reflection of the genotype of the queen and also of her individual size and vigor. For example, as the body weight increases, the number of ovarioles increases (Hoopingarner and Farrar 1959). Thus, part of the variation that is frequently observed among many queens that inherit similar size and body conformation (Roberts 1961) is the result of variations in environmental factors during rearing.

Methods of queen rearing vary considerably, but most beekeepers feel that the best queens are produced as a result of normal supersedure within a strong colony. The further a method deviates from the normal, the greater the chances that some queens will suffer from unfavorable environment. However, the common methods of producing large numbers of queens tend to combine in varying degrees supersedure, swarming, and queenlessness. The result is the production of too many undersized queens because the quantity and quality are influenced by the food and temperature inside and outside the hive.

A Common Method of Queen Rearing

Usually queen rearing consists of starting queen cells in a swarm box and then transferring them to a finishing colony. The queen cell finishing colony therefore consisted of a normal colony of good strength in a 2-story brood nest. Once each week, two to four combs containing unsealed brood were raised immediately above into a third story that was separated by a queen excluder. The idea was to attract the nurse bees to the queen cells by placing them as close as possible to the younger worker larvae. However, no more than 20 such started cells were placed between two frames of young larvae at one time because this type of rearing colony has 3,000 to 4,000 young worker larvae that require royal jelly and as many older larvae that must also be fed by the nurse bees. (Detrimental effects can result if larvae are kept away from the nurse bees for an excessive time because they receive insufficient feeding and are exposed to adverse temperature and humidity.)

Double Grafting Procedure

The Madison laboratory adopted the double grafting procedure (Roberts 1945) in 1945 because double grafted queens were conspicuous for greater uniformity and size of queens. Twenty-four to 48-hour-old larvae were grafted to obtain cells well provisioned with royal jelly. These larvae and cells were placed in a swarm box. Then, 24 hours later, these larvae were removed, and 1- to 12-hour-old larvae were regrafted (double grafted) onto the royal jelly. The regrafted cells were then put into the finishing colony as quickly as possible.

Specialized Finishing Colony

The use of a more specialized finishing colony was subsequently explored by Dr. C. L. Farrar with the objective of reducing the time required to reorganize the brood, to provide full combs of brood of the same age, to avoid robbing when it was difficult to find the queen, and to increase the colony's capacity to rear more queen cells of high quality. These objectives were met by organizing special colonies

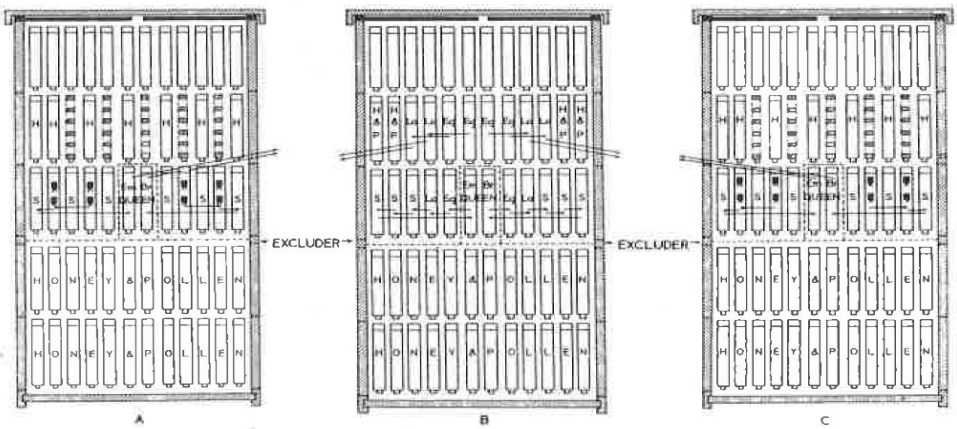

Figure 1. A and C. Organization of queen rearing colonies. B. Organization of supporting brood colony for two rearing colonies. (H = honey, S = sealed brood, P = pollen, Em Br = emerging brood, La = larvae, Eg = egg, frames of pollen = (A & C, second row from top, alternating light and dark frames), queen cells = (A & C, third row, dark squares with legs)

[1] Research supported by the College of Agricultural and Life Sciences, University of Wisconsin, Madison 53706.

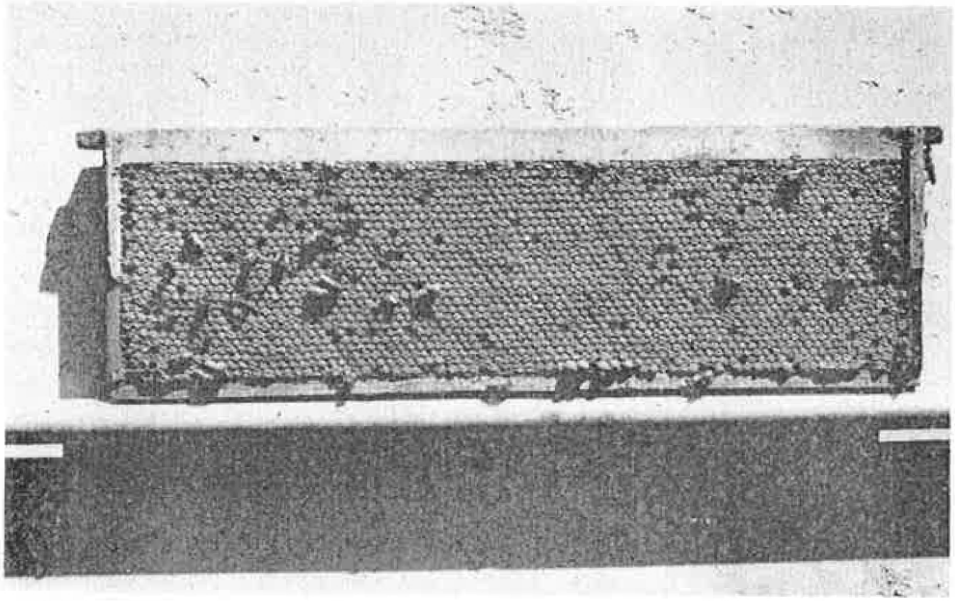

Figure 2. Brood obtained by confining queen on two 6¼-inch dark combs.

(shown in Fig. 1) according to two basic principles set forth by Dr. Farrar: the colonies must be full strength with proportionate numbers of all physiological age groups; and they should have no larvae to feed other than the queen larvae that are provided. The procedure has now been used successfully at this laboratory for about 15 years. I have modified this procedure by eliminating the swarm box and grafting directly into the finishing colony so that 80 regrafted cells are reared at one time (in one colony once a week) without sacrificing quality, as is demonstrated by the large uniform-sized queens produced. All this is possible because the nurse bees are not required to feed 6,000 to 8,000 worker larvae, and the lack of balance between the larval and the adult population simulates the condition common to colonies that supersede their queen. The full frame of brood (Fig. 2) obtained by confining the queen permits the location of all queen cells adjacent to brood, which provides an optimum temperature environment.

The Farrar square hive body that holds twelve 6½-inch frames is best adapted for this plan of queen rearing. (It can be adapted to other shallow equipment with equally good results, but the system of rotating the brood would have to be modified to suit the equipment.) A 2-frame queen compartment is made exactly in the center of one hive body of each colony by permanently attaching a wire queen excluder to the bottom edge and fitting two pieces of wire excluder perpendicular to the bottom excluder to provide the 3⅝-inch space. Square queen excluders are not standard, but a 10-frame excluder can be made square by welding a piece from another excluder and making new end pieces or by using a (16¼ inch) 10-frame excluder with two 1⅞-inch wood cleats on either side to complete coverage of the bottom of the square hive (Fig. 3).

Excluder Compartment. The excluder compartment is supported by sawing accurately spaced saw kerfs and cutting into both ends of the hive body before it is assembled. The depth of cuts is determined by the length of unbound wire excluder strips. The excluder strips are of a width to form a tight closure with the bottom excluder and are level with the top edge of the hive body. They should be permanently attached to the bottom excluder and shimmed tightly at the rabbeted ends of the hive body. A strip of tightly fitted zinc excluder is used to close the queen's compartment, which consists of a space adequate to hold two frames for egg laying.

Preparing the Colonies. It is best to transfer normal, strong colonies into the special equipment 3 weeks before the start of queen rearing operations to obtain 12 full combs of brood of known age. The queen should be confined on two dark combs with at least one comb containing some emerging brood. Two shallow combs contain 8,250 cells, ample space for a prolific queen if these combs contain no great amount of honey and pollen. The remaining brood is placed on either side of the excluder compartment according to age, with the youngest towards

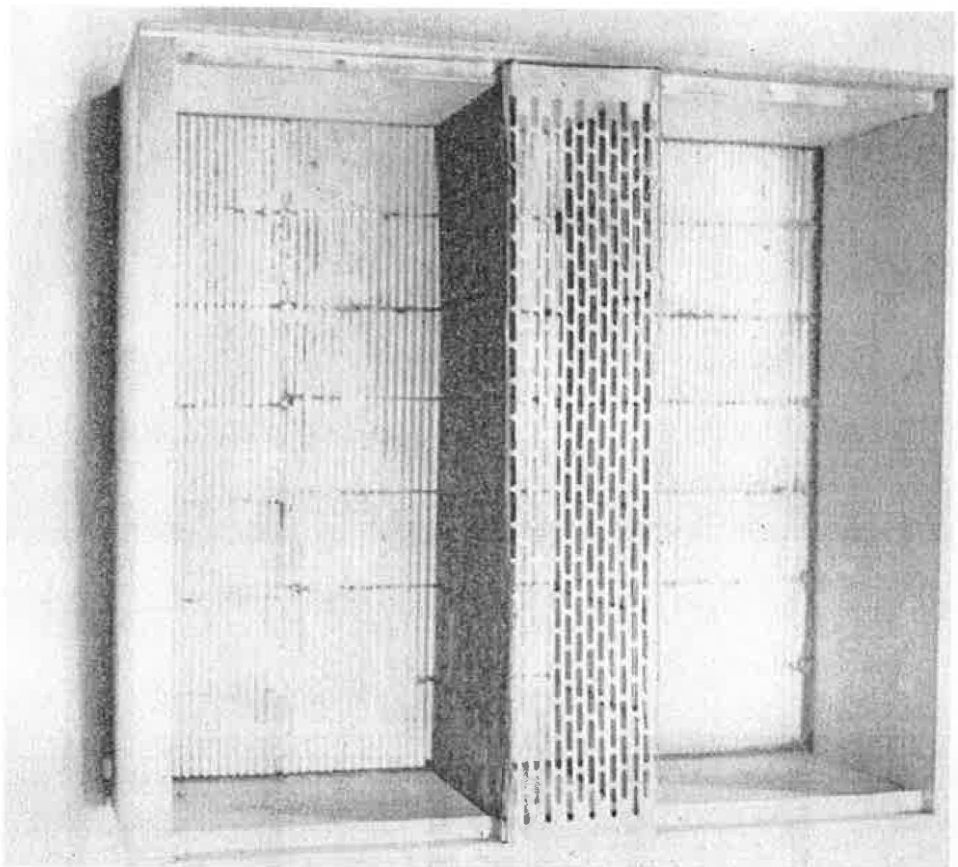

Figure 3. Excluder compartment. Covered.

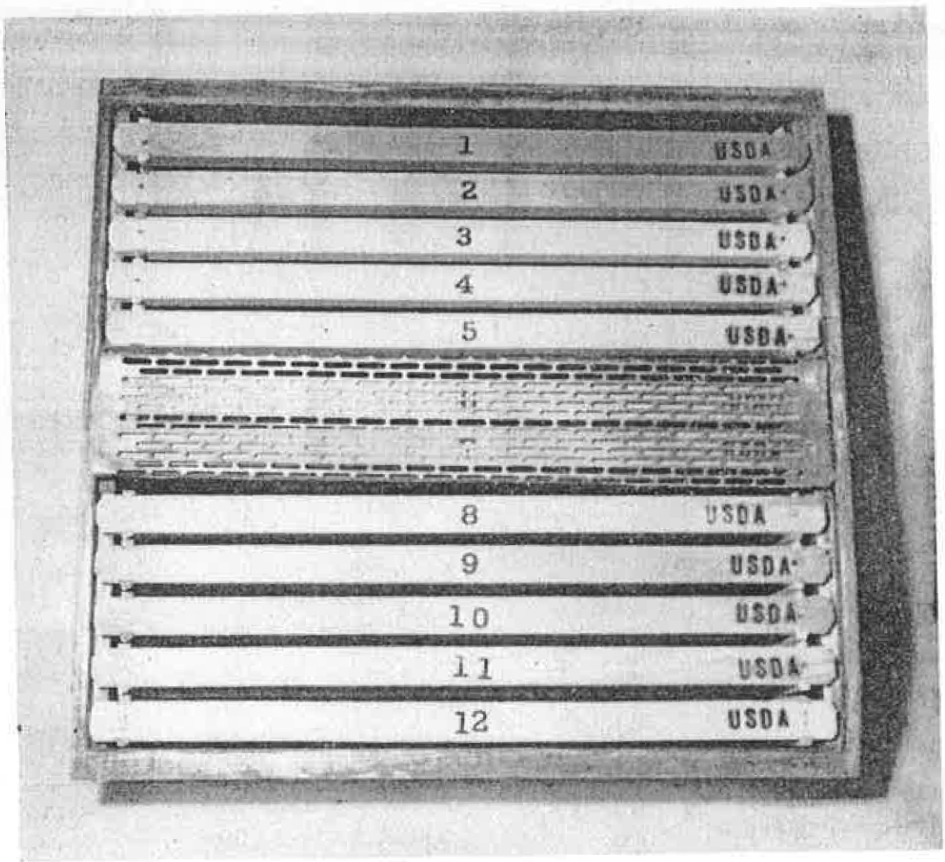

Figure 4. Shows frames 6 and 7 in the excluder compartment, covered. All frames are rotated through the excluder compartment at 3½-day intervals.

the center of the compartment. Twice a week (Monday afternoon and Friday morning), two combs are rotated into the queen's compartment, and the eggs and young larvae are moved outside but adjacent to the compartments. The procedure is repeated twice a week until the queen has all her brood in 12 combs with the youngest to the center and the oldest brood next to the outside wall of the hive.

Organization of Queen Cell Finisher And Brooding Rearing Colonies

Three weeks later the colonies are ready to be organized into queen cell rearing and brood rearing colonies. One brood rearing colony is used for each two queen rearing colonies. The brood rearing colony is kept in brood rotation at 3½-day intervals.

The combs containing eggs and larvae of feeding age from the two queen rearing colonies are placed in the brood rearing colony immediately above the excluder compartment with the youngest larvae to the center. These same combs, since they contain larvae that are being sealed, are transferred back to the parent colonies on the third rotation. In the transfer, the bees are shaken from all combs of the cell finisher and brood rearing colonies so as to maintain the population of each.

DETAILED PROCEDURES

Queen Rearing. On Monday afternoon and Friday morning, two combs of eggs and hatching larvae (Fig. 4, positions 6 & 7) are moved from the excluder compartments of two queen rearing colonies (Fig. 1 A & C) and placed immediately above the excluder compartment (Fig. 4, positions 5 & 6 or 7 & 8) of the brood rearing colony (Fig. 1 B). The two combs of emerging brood (Fig. 4, positions 1 & 12) are placed in the excluder compartment with the queen, and the remaining brood is rotated outward to make room next to the excluder compartment for the sealed brood that are returned from the brood rearing colony. (Position numbers indicate the location in the 12-frame hive when numbered from one side to the other; frame numbers shown in Figure 4 pertain to brood comb and the series of rotation.)

Grafted queen cells are placed in positions 2, 4, 9, and 11 if 8 bars (4 frames) are given at one time when Monday (or Thursday) is used for the first graft and Tuesday (or Friday) is used for the second or double grafted larvae. If only 4 bars are grafted, the 2 frames are placed in positions 4 and 9; if another 4 bars are given before the first cells emerge the following week, the older ones are moved to positions 2 and 11, and the new graft is placed in positions 4 and 9. Figure 5 shows ripe queen cells obtained by double grafting and ready for caging.

Additional chambers above the brood nest are required only for honey storage; otherwise, they are kept below the excluder compartment until the colony is reorganized for winter.

Brood Rearing Colony. The brood rearing colony is managed in a similar manner except that the 12 frames of brood are rotated within one chamber (youngest toward center, oldest to the outside). This colony (Fig. 1 B) is positioned between two queen rearing

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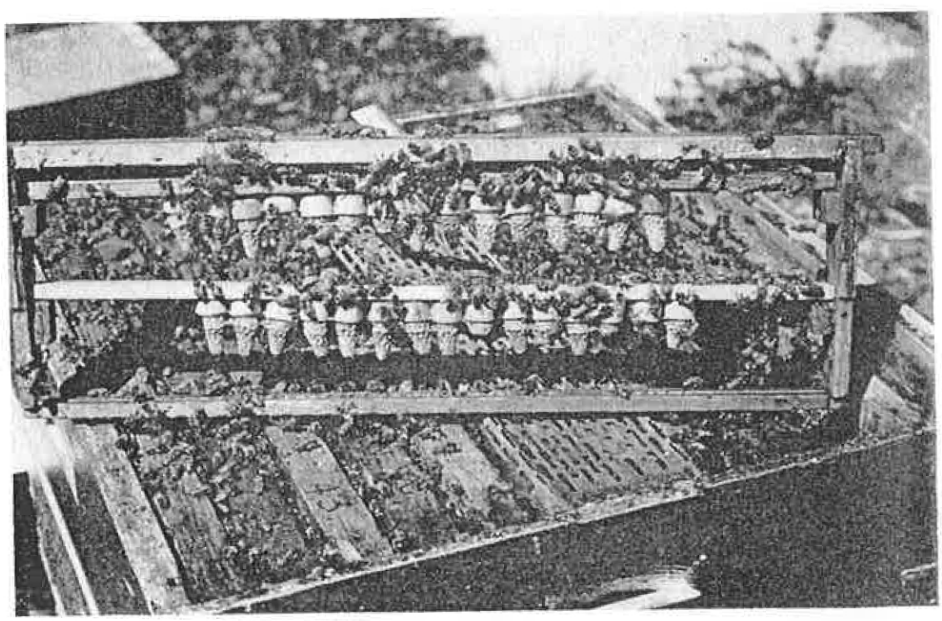

Figure 5. Ripe queen cells obtained by double grafting that are ready for caging.

cient honey to satisfy consumer demand. Several commercial operators must purchase honey from wholesale dealers in New York and other states, and various national brands of honey comprise the stock in many supermarkets.

It has been said that the hobbyist is the backbone of the beekeeping industry, and certainly Connecticut — with only eight commercial beekeepers — is ample evidence of that proposition. In many instances it is the hobbyist and his several pounds of surplus honey who first 'hooks' his neighbors on the sweet product of the honey bee. It may also be the hobbyist who has the time to extoll the value and the virtues of honey, as well as interest others in becoming beekeepers.

The hobbyist, in fact, may well be the key to any predictions concerning the future of beekeeping in Connecticut. New hobbyists may enter the ranks, other hobbyists may enlarge their apiaries into commercial enterprises. The recent boom in health foods and the higher prices being paid per jar may stimulate more people to consider beekeeping and/or induce former beekeepers to take up beekeeping again. It is noteworthy that a brief, one-day course in beekeeping was offered last spring at Central Connecticut State College in New Britain, and more than 80 persons enrolled. A longer course is being offered again this spring and enrollment again is high. Moreover, attendance at Connecticut Beekeepers' Association meetings has increased in the past few years.

In any event, we anticipate comparing our present statistics with those that will be compiled by the bee inspectors in 1977. Hopefully, we may then have the pleasure of reporting that the decline in the state's apiaries, colonies and beekeepers has come to a halt — and that instead, an upward trend has begun to take place.

ACKNOWLEDGMENTS

We wish to express our appreciation to University of Connecticut students Mr. Kevin Donovan and Donald Stafstrom for assisting with the data collecting and to Dr. George Schuessler of the Connecticut Agricultural Experimental Station for loan of the bee inspectors reports. We are indebted to Mr. Paul Lazarus for reviewing the manuscript.

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[2] **Hewitt, P. J. Jr. (1960)** The number of apiaries and colonies in Connecticut (unpublished).

[3] **Beekeeping statistics 1965-1969** revised American Bee Journal (1973) 113:51.

COMMUNICATION AMONG HONEYBEES —

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source. Olfactory clues are widely used among the bees in locating certain food sources. Perhaps by more fully understanding the complexities of bee language, man may come to understand more about communication among other creatures.

FOOTNOTES

[1] **Harold Esch,** "The Evolution of Bee Language," **Scientific American,** August, 1967, p. 97.

[2] **Adrian M. Wenner,** "Sound Communication in Honeybees," **Scientific American,** April, 1964, p. 117.

[3] **Karl von Frisch, The Dance Language and Orientation of Bees** (Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1967), p. 29.

[4] **Wenner, op. cit.,** p. 117.

[5] **Jay Chamblin,** "Dance Versus Smell," **Science News,** April 19, 1969, p. 383.

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Czechoslovakia

The government is promoting and subsidizing transfers of bee colonies to certain crops and orchards. In 1969 about 14,800 hives were transferred by 31 associations of beekeepers. In 1972, there were 50 associations participating in these transfers with 24,144 hives. The largest participants get a special recognition from the ministry of agriculture. The beekeepers delivered to the government according to its instructions 2300 tons of honey. The highest delivery 64.84 pounds per 1 hive came from the beekeepers of Valec. From Vcelarstvi (Czechoslovakian Beekeepers Magazine)

REARING OF HONEYBEE QUEENS

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colonies (Fig. 1 A & C). The three colonies (Fig. 1 A, B, & C) form a set of queen rearing colonies. Then, four frames of eggs from two queen rearing colonies (Fig. 1 A & C) are placed immediately above the excluder compartment (positions 5 to 8) with the respective four frames of larvae adjacent to them (positions 3, 4, & 9, 10 — Fig. 1 B). At the same time, the four frames of mostly sealed brood given 7 days before are returned to their respective colonies. With this compact arrangement, the young brood from three queens appears to be as well cared for as the larvae from one queen distributed through a normal brood nest.

Colony Requirements — Queen Rearing and Brood Rearing Colonies

1. A good queen must be supported by a large population with plenty of honey and pollen.
2. A large reserve of honey and pollen should be maintained below the brood nest at all times to serve as an automatic feeder. (Honey below the brood nest is not in a normal position so the bees constantly move it upward.)
3. Full combs of sealed brood are necessary to maintain a favorable temperature environment for all queen cells placed in the colony.
4. During a honey flow, a super of **dark combs** that provides an excess of storage space must be located immediately above the brood nest to prevent the bees from crowding the brood nest. (Foundation or white combs will not accomplish this.) When the first super becomes half full, another super of **dark combs** must be added underneath the first.
5. Rapid colony manipulation is necessary so robbing will be kept at a minimum.

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Eat More Honey!